

REMARKS/ARGUMENTS

The amendments to the specification correct clearly typographical errors. As addressed in Section I, the amendments to the specification also correct informalities. No new matter has been added by the amendments to the specification.

Claims 1-33 and 36-52 are pending in the present application. Claims 1-32 and 36-51 are amended. Claims 33-35 and 52 are cancelled. Claims 53 and 54 are added. Support for the claim amendments can be found in the claims as originally filed and in the Applicants' patent application on page 11, line 20 – page 12, line 13; page 13, lines 1-4; and Figure 3. Reconsideration of the claims is respectfully requested.

I. Objection to the Specification

The Examiner objected to the specification as containing informalities. Applicants have amended the specification accordingly, thereby overcoming the objection.

II. Nonstatutory Double Patenting; Claims 1-3, 17-19, 36, 37, 44, and 45

The Examiner rejected claims 1-3, 17-19, 36, 37, 44, and 45 on the ground of nonstatutory obviousness-type double patenting as unpatentable over claims 1 and 2 of U.S. Patent Application 10/714,049. An appropriate terminal disclaimer is included in this response. Accordingly, the rejection is overcome.

III. 35 U.S.C. § 102, Anticipation; Claims 1-33 and 36-53 and New Claims 53 and 54

The Examiner rejected claims 1-33 and 36-53 under 35 U.S.C. § 102 as anticipated by *Sun, Reliable Multicast for Publish/Subscribe Systems*, Massachusetts Institute of Technology, May 2000. Claims 33 and 52 are cancelled, rendering the rejection against these claims moot. With respect to the remaining claims, the rejection is respectfully traversed. With regard to amended claim 17, which is representative of amended claims 1, 36, and 44, the Examiner states:

Regarding claims 1, 17, 36, and 44, *Sun* anticipates a publish/subscribe messaging system/method (abstract) comprising: at least one broker (Figure 3-1) and at least one subscriber (abstract), the broker having means for sending a status request message to the subscriber (pg. 14), and means for receiving an indication of liveness of the subscriber (pp. 30-31).

Office Action dated May 16, 2007, p. 5.

A prior art reference anticipates the claimed invention under 35 U.S.C. § 102 only if every element of a claimed invention is identically shown in that single reference, arranged as they are in the claims. *In re Bond*, 910 F.2d 831, 832, 15 U.S.P.Q.2d 1566, 1567 (Fed. Cir. 1990). All limitations of the

claimed invention must be considered when determining patentability. *In re Lowry*, 32 F.3d 1579, 1582, 32 U.S.P.Q.2d 1031, 1034 (Fed. Cir. 1994). Anticipation focuses on whether a claim reads on the product or process a prior art reference discloses, not on what the reference broadly teaches. *Kalman v. Kimberly-Clark Corp.*, 713 F.2d 760, 218 U.S.P.Q. 781 (Fed. Cir. 1983). In this case, every feature of the presently claimed invention is not identically shown in the cited reference, arranged as they are in the claims.

Sun does not anticipate amended claim 17 because *Sun* does not disclose each and every feature of amended claim 17. Amended claim 17 is as follows:

17. A method for liveness monitoring in a publish/subscribe messaging system having at least one broker and at least one subscriber, the method comprising:
 - sending a status request message from the at least one broker to the at least one subscriber,
 - responsive to each subscriber receiving the status request message from the at least one broker, setting a timer for each subscriber of the at least one subscriber, and
 - responsive to the timer expiring, sending a multicast message claiming response to the at least one broker from a particular subscriber of the at least one subscriber.

Sun does not disclose all of the features of amended claim 17. Specifically, *Sun* fails to disclose the feature of responsive to the timer expiring, sending a multicast message claiming response to the at least one broker from a particular subscriber of the at least one subscriber. The Examiner cites portions of *Sun* with respect to the features of “setting a timer upon receipt of a status, request message from the broker” and “sending, on expiry of the timer, a multicast message claiming response to the broker,” as recited in original claim 21. Applicants now address these portions of *Sun* to show that *Sun* fails to disclose the feature of responsive to the timer expiring, sending a multicast message claiming response to the at least one broker from a particular subscriber of the at least one subscriber, as recited in amended claim 17. Specifically, the Examiner cites the following portion of *Sun*:

Our hybrid protocol, *rpbcast*, uses the same sender and logger modules as described in Section 3.1 and 3.2. However, the receiver module in *rpbcast* is the combination in functionalities of the two receiver modules described in Section 3.3 and 4.1. Luckily, the two receiver modules have very little overlap in their functionalities. The only overlap is adding a newly arrived message to *deliverbuf*. Therefore, the receiver module in *rpbcast* simply combines the two receiver modules into one big module. The only necessary addition to the big module is a mechanism for moving missing message IDs from *gmissing* (missing ID set in the gossip based recovery) to *missing* (missing ID set in the logger based recovery). when those messages can no longer be recovered through gossip phase. There are two simple solutions. The first solution just moves message IDs from *gmissing* to *missing* if the IDs have been in

gmissing for a "long" time. This solution can be implemented by a receiver without knowing anything about the rest of the system. The drawback is that we always pay this time delay while an ID remains in *gmissing*, even though gossip phase might have already failed to recover the message.

Sun, page 40, paragraph 2.

Neither the cited portion nor any other portion of *Sun* discloses the feature of responsive to the timer expiring, sending a multicast message claiming response to the at least one broker from a particular subscriber of the at least one subscriber. *Sun* discloses a system for increasing the reliability of multicasting by using a hybrid protocol that includes elements of both peer-based and logger-based packet recovery systems. Specifically, *Sun*'s system includes three phases. The first phase mass distributes a packet to all receivers through an unreliable multicast primitive. *Sun*, page 19. The second phase repairs lost packets in a distributed manner using periodic gossips, which corresponds to a peer-based packet recovery system. *Id.* If phases one and two fail, then phase three utilizes loggers for re-transmission. *Id.* The cited portion describes the combination of two receiver modules to implement the hybrid protocol, which share a common buffer named "*deliverbuf*." The cited portion also discloses transferring IDs for missing message from a "*gmissing*" data set to a "*missing*" data set. A message ID resides in the *gmissing* data set when *Sun*'s system is attempting to recover the message using peer-based recovery. If *Sun*'s system fails to recover the message using peer-based recovery, then the message ID is transferred to the *missing* data set. The message ID resides in the *missing* data set while *Sun*'s systems attempts to recover the message using logger-based recovery. The cited portion also explains an approach, which is not used by *Sun*'s system, for transferring message IDs from *gmissing* to *missing* in which the message is transferred after a "long" time. However, transferring a message ID from *gmissing* to *missing* is not the same as sending a multicast message claiming response to a broker because no multicast message is sent to a broker in the process of transferring a message ID from *gmissing* to *missing*.

On the other hand, amended claim 17 recites the feature of responsive to the timer expiring, sending a multicast message claiming response to the at least one broker from a particular subscriber of the at least one subscriber. The cited portion differs from the claimed feature because the cited portion nowhere discloses sending a multicast message in response to a timer expiring, let alone sending a multicast message to a broker.

For example, in the only part of the cited portion that relates to a time-sensitive process, the cited portion states that "[t]he first solution just moves message IDs from *gmissing* to *missing* if the IDs have been in *gmissing* for a 'long' time." The cited statement discloses only that a message ID is sent from one data set, *gmissing*, to another data set, *missing*. Even assuming, *arguendo*, that a message ID is the same as a message claiming response and that a "long time" is the same as the expiry of a timer, as claimed, the

cited statement still fails to disclose that the message ID is multicast. In fact, the cited statement explicitly discloses otherwise because the cited statement discloses that a message ID is transferred from one data set to one other data set. Furthermore, the cited statement nowhere mentions a sender, receiver, or logger, which are the three members of *Sun*'s multicast publish/subscribe system, and instead discloses only the transfer of a message ID between two abstract data sets after a "long" time. Hence, the cited statement also fails to disclose a message that is sent from a broker to a subscriber of the multicast publish/subscribe system in response to a timer expiring, as claimed. Hence, the cited portion of *Sun* fails to disclose the feature of responsive to the timer expiring, sending a multicast message claiming response to the at least one broker from a particular subscriber of the at least one subscriber. As shown in further detail below, no other portion of *Sun* discloses this claimed feature.

The Examiner also cites the following portion of *Sun*, which is provided below in conjunction with Figure 4-4:

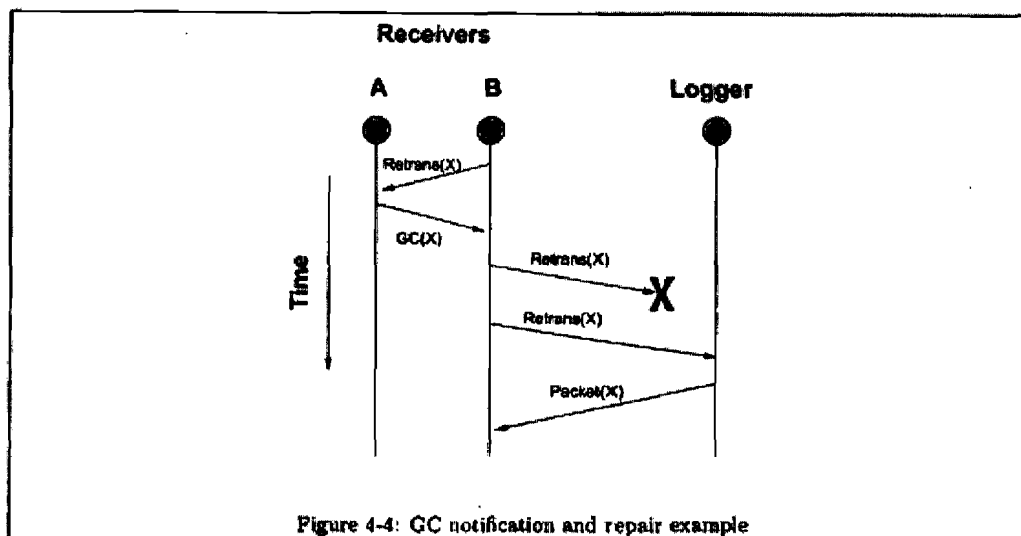
In the combined implementation, whenever we detect a new missing message, we always add it to *gmissing* - initiating gossip recovery for that message. Missing message ID will migrate from *gmissing* to *missing*, ie. move from gossip phase to logger phase, after a garbage collection notification (*GcNOTE*). We generate a *GcNOTE* if and only if the requested message is not in our gossipbuf and that we have received the message before. This *GcNOTE* generation condition is true and sufficient for two reasons. First. Property 3.5 implies that we have received the message before, i.e. added to gossipbuf. Second, gc is the only call that removes messages from gossipbuf. Therefore, not in gossipbuf implies local garbage collection has occurred.

To ensure that rpbcast still satisfies our specification and liveness, we need to augment our simulation relation *f* to include *gmissing* as part of the missing message set. The remaining catch is to augment the liveness condition such that a message ID is eventually removed from *gmissing*:

Property 4.1 For each missing message *m*, *m* is either recovered during the gossip phase or eventually passed on to the logger phase recovery.

The first half of the claim is obvious from construction. To show the second half of the claim, we note that local garbage collection of *m* will eventually occur. In other words, there exists a time *t* in the execution such that $m \notin \text{gossipbuf}_i$ for all *i* and time after *t*. Therefore, after time *t*, periodic gossip messages for retransmission of *m* will eventually result in the arrival of a corresponding *GcNOTE* message and removal of the ID from *gmissing* as desired. Using Property 4.1 and the correctness of the logger based recovery shown in Chapter 3, we conclude rpbcast satisfies our specification and liveness condition in Section 2.1. At this point, we have completed the description of our hybrid protocol rpbcast. We will now proceed to propose several "optimizations" and resolve some of the nagging details.

Sun, page 42, first paragraph – page 43, last paragraph.



Sun, Figure 4-4.

Neither the cited portion nor any other portion of *Sun* discloses the feature of responsive to the timer expiring, sending a multicast message claiming response to the at least one broker from a particular subscriber of the at least one subscriber. In the “gossip” phase of *Sun*’s system, a receiver that is missing a message may target another receiver to acquire the message from the gossip target. However, if the message does not exist in the “gossipbuf” set of messages for the gossip target, then the gossip target generates a garbage collected notification, which *Sun* calls a “GcNOTE.” The GcNOTE initiates the transfer of the missing message ID from *gmissing* to *missing*. The cited portion discloses a time *t*, after which the missing message is removed from the gossip target’s *gossipbuf*. However, the cited portion nowhere discloses sending a multicast message between a subscriber and a broker after time *t*.

On the other hand, amended claim 17 recites the feature of responsive to the timer expiring, sending a multicast message claiming response to the at least one broker from a particular subscriber of the at least one subscriber. The cited portion differs from the claimed feature because the cited portion fails to disclose that the GcNOTE is a multicast message between a subscriber and a broker. In fact, *Sun* explicitly discloses otherwise.

For example, in a non-cited portion, *Sun* states, “[t]his notification will alert the gossiper to move the missing message ID from *gmissing* to *missing*.” *Sun*, page 40, paragraph 3. Furthermore, Figure 4-4, cited above, explicitly illustrates that the GcNOTE is passed from the gossip target to a single receiver. Because the GcNOTE is transmitted to only one single receiver, the GcNOTE is not multicast. Hence, the cited portion fails to disclose sending a multicast message claiming response upon a timer expiring.

Furthermore, the cited portion discloses that the GcNOTE is transferred between two receivers: the gossip target and the gossipper. This transfer is also illustrated in Figure 4-4, which shows a GcNOTE being transferred between receiver A and receiver B. In fact, the entire purpose of the gossip phase of

Sun's system is to provide missing messages to receivers without the need to acquire the message from a logger or sender. Hence, *Sun* fails to disclose the feature of responsive to the timer expiring, sending a multicast message claiming response to the at least one broker from a particular subscriber of the at least one subscriber. Accordingly, *Sun* fails to disclose all of the features of amended claim 17.

Because amended claim 17 is representative of amended claims 1, 36, and 44, the same distinctions between amended claim 17 and *Sun* apply to claims 1, 36, and 44. Because claims 2-16, 18-32, 37-43, and 45-51 and new claims 53 and 54 depend from amended claims 1, 17, 36, and 44, at least the same distinctions between *Sun* and amended claims 1, 17, 36, and 44 applies for these claims as well. Additionally, claims 2-16, 18-32, 37-43, and 45-51 and new claims 53 and 54 claim other additional combinations of features not disclosed by the reference. Therefore, the rejection of claims 1-32 and 36-51 under 35 U.S.C. § 102 has been overcome.

Furthermore, *Sun* does not teach, suggest, or give any incentive to make the needed changes to reach the presently claimed invention. Absent the Examiner pointing out some teaching or incentive to implement *Sun* and the teaching of responsive to the timer expiring, sending a multicast message claiming response to the at least one broker from a particular subscriber of the at least one subscriber, as claimed, one of ordinary skill in the art would not be led to modify *Sun* to reach the present invention when the reference is examined as a whole. Absent some teaching, suggestion, or incentive to modify *Sun* in this manner, the presently claimed invention can be reached only through an improper use of hindsight using Applicants' disclosure as a template to make the necessary changes to reach the claimed invention.

IV. 35 U.S.C. § 102, Anticipation; Claims 12 and 28

The Examiner rejected claims 12 and 28 under 35 U.S.C. § 102 as anticipated by *Sun*. This rejection is respectfully traversed. With regard to amended claim 28, which is representative of amended claim 12, the Examiner states:

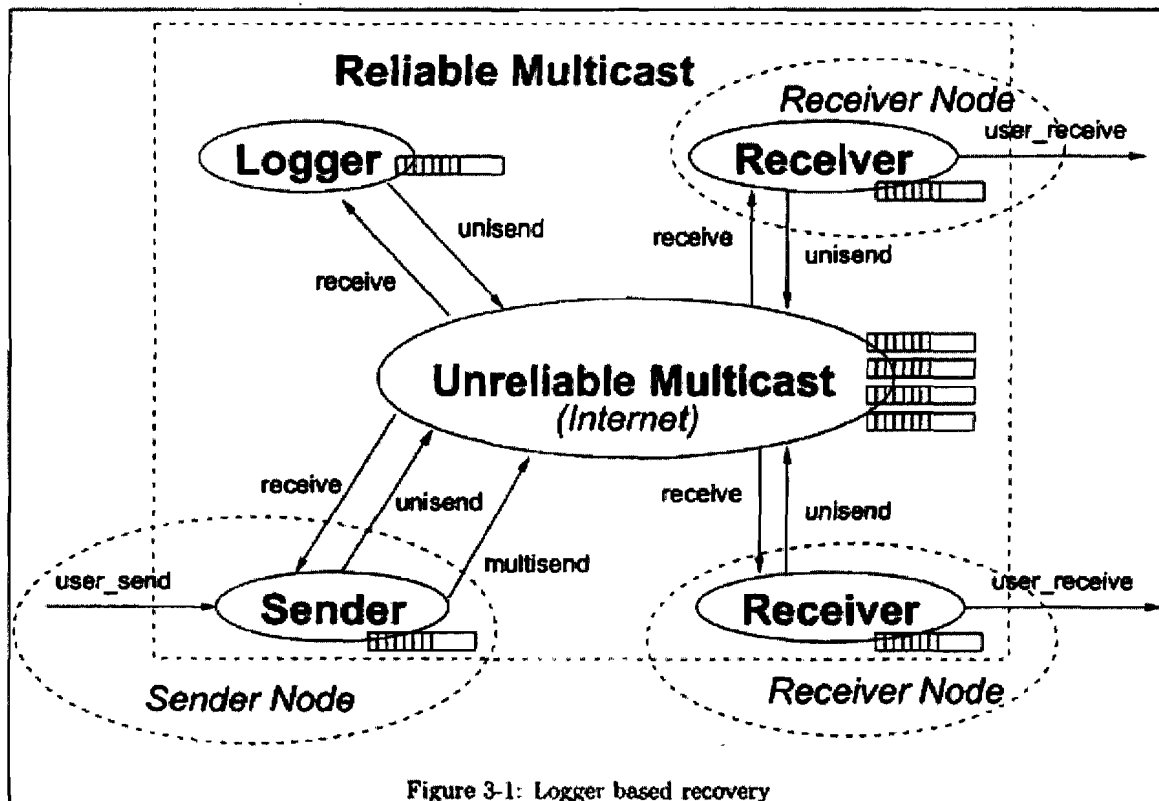
Regarding claims 12 and 28, *Sun* anticipates a publish/subscribe messaging system according to claims 1 and 17, wherein the broker is arranged to designate as a primary subscriber (p. 13; Figure 3-1) the first subscriber to register interest in a topic (p. 13), and to maintain an active connection to the primary subscriber for sending directly to the primary subscriber a status request message (p. 43), and in the event of failure of the primary subscriber to send (p. 43) a status request message to at least one other subscriber and to designate (p. 43) as a new primary subscriber the at least one of the other subscribers whose indication of liveness is next first received (p. 43).

Office Action dated May 16, 2007, p. 8.

Amended claim 28 is as follows:

28. The method of claim 17, further comprising:
designating a first subscriber of the at least one subscriber to register interest in a topic as a primary subscriber,
maintaining an active connection to the primary subscriber for sending the status request message directly to the primary subscriber, and
responsive to a failure of the primary subscriber to send an indication of liveness and responsive to a different subscriber of the at least one subscriber sending the indication of liveness, designating the different subscriber as a new primary subscriber.

Sun fails to disclose all of the features of amended claim 28. Specifically, *Sun* fails to disclose the feature of designating a first subscriber of the at least one subscriber to register interest in a topic as a primary subscriber. The Examiner cites portions of *Sun* with respect to the feature of “at the broker, designating as a primary subscriber the first subscriber to register interest in a topic,” as recited in original claim 28. Applicants now address these portions of *Sun* to show that *Sun* fails to disclose the feature of designating a first subscriber of the at least one subscriber to register interest in a topic as a primary subscriber, as recited in amended claim 28. The Examiner cites the following portions of *Sun*:



Sun, Figure 3-1.

Pub / sub systems are middleware for "gluing" together heterogeneous applications that operate on the same information space. These system are divided into three broad classes, based on their

information filtering and routing mechanisms. The first class of pub/sub systems is *channel-based*. These systems have a number of predefined channels. Each channel has a designated topic. Information publishers send new events to the appropriate channels. All interested subscribers listen directly on each channel for new events. The CORBA Event Service [15] is an example of a channel-based pub/sub system.

The second class of pub/sub systems is *subject-based*. Instead of predefined channels, events are published into the system with specific topics in the subject field. Subscribers provide subscriptions that filter against the subject field to extract interested events. A classic example is the newsgroup. Another example is TIBCO Rendezvous [19] system. In TIBCO, the subject field consists of a string such as thesis.Sun.qixiang. A subscription filter is a regular expression. For example, the subscription filter thesis.*.* will select all theses.

The third class of pub/sub systems is *content-based*. These systems not only allow filtering based on the subject but also on the entire content of an event. The content of an event is specified with a collection of attributes, e.g. {type=thesis, author=Sun}. Through the introduction of attributes, content-based pub/sub systems allow individual subscribers more expressiveness in selecting the type of events they are interested in and migrate the burden of event matching to the underlying middleware. Examples of content-based pub/sub systems include Elvin [34], SIENA [10], and Gryphon [2, 5].

A related field to pub/sub systems is group communication, pioneered by ISIS [8]. These systems focus on providing a general distributed framework for processes to collaborate on a common task. To simplify correctness analysis of a distributed algorithm or application, ISIS introduces the virtual synchrony (VS) model. Under VS, group membership changes are ordered along with regular messages. Moreover, if two processes proceed together from one view to another, then they deliver the same messages in the first view. These constraints allow ISIS to enforce total and/or casual ordering of messages in faulty environments. In the event of a network partitioning, ISIS allows only the primary partition to continue operating.

Transis [3] extends ISIS by supporting partitionable operations. Instead of only permitting the primary partition to continue, Transis allows each partition to proceed together and "merge" the results when network partition heals. The nature of the merge operation is obviously application dependent. In some cases, the merge operation implies exchange missing messages. In others, merging might involve combining partial but independent results. Transis also introduces the notion of hidden views to assist in merging and totally order past view history. Totem [1] imposes an even stronger consistency model than Transis through extended virtual synchrony (EVS) [27]. EVS guarantees that if messages are delivered to multiple components of a partitioned network, then the message ordering is consistent in all of these components. The added constraint simplifies the recovery process for maintaining exact replicas.

Though group communication's emphasis on consistency and replicated data items is orthogonal to the functions of pub/sub systems, there are many similarities in the underlying multicast transport

protocols. For instance, system scalability and low message delivery latencies are common concerns in designing multicast protocols for group communications and publish/subscribe systems. Techniques such as vector timestamp and randomized gossip are useful in both cases.

Sun, pages 12-13.

Neither the cited portion nor any other portion of *Sun* discloses the feature of designating a first subscriber of the at least one subscriber to register interest in a topic as a primary subscriber. The cited portion describes three classes of pub/sub systems: channel-based, subject-based, and content-based. In a subject-based system, subscribers extract only those events that relate to a particular subject field. In a content-based system, subscribers extract events based on the both the subject field of the event and the specific content of the event. However, the cited portion nowhere discusses the order in which subscribers register interest in a topic.

On the other hand, amended claim 28 recites the feature of designating a first subscriber of the at least one subscriber to register interest in a topic as a primary subscriber. The cited portion differs from the claimed feature because the cited portion does not distinguish between subscribers based on the order in which they register interest in a topic, let alone discloses a first subscriber to register interest in a topic. In fact, the cited portion does not address the order in which subscribers register interest in a topic at all.

For example, the cited portion states, “[s]ubscribers provide subscriptions that filter against the subject field to extract interested events.” The cited statement generally describes subscribers’ access to events in interested subject field, but nowhere addresses the order in which subscribers access or express interest in those events. Hence, neither the cited portion nor any other portion of *Sun* discloses the feature of designating a first subscriber of the at least one subscriber to register interest in a topic as a primary subscriber. Therefore, *Sun* does not disclose all of the features of amended 28. Because amended claim 28 is representative of amended claim 12, *Sun* also fails to disclose all of the features of amended claim 12.

V. 35 U.S.C. § 102, Anticipation; Claims 13, 15, 16, 31, 29, and 32

The Examiner rejected claims 13, 15, 16, 31, 29, and 32 under 35 U.S.C. § 102 as anticipated by *Sun*. This rejection is respectfully traversed. With regard to amended claim 29, which is representative of amended claim 13, the Examiner states:

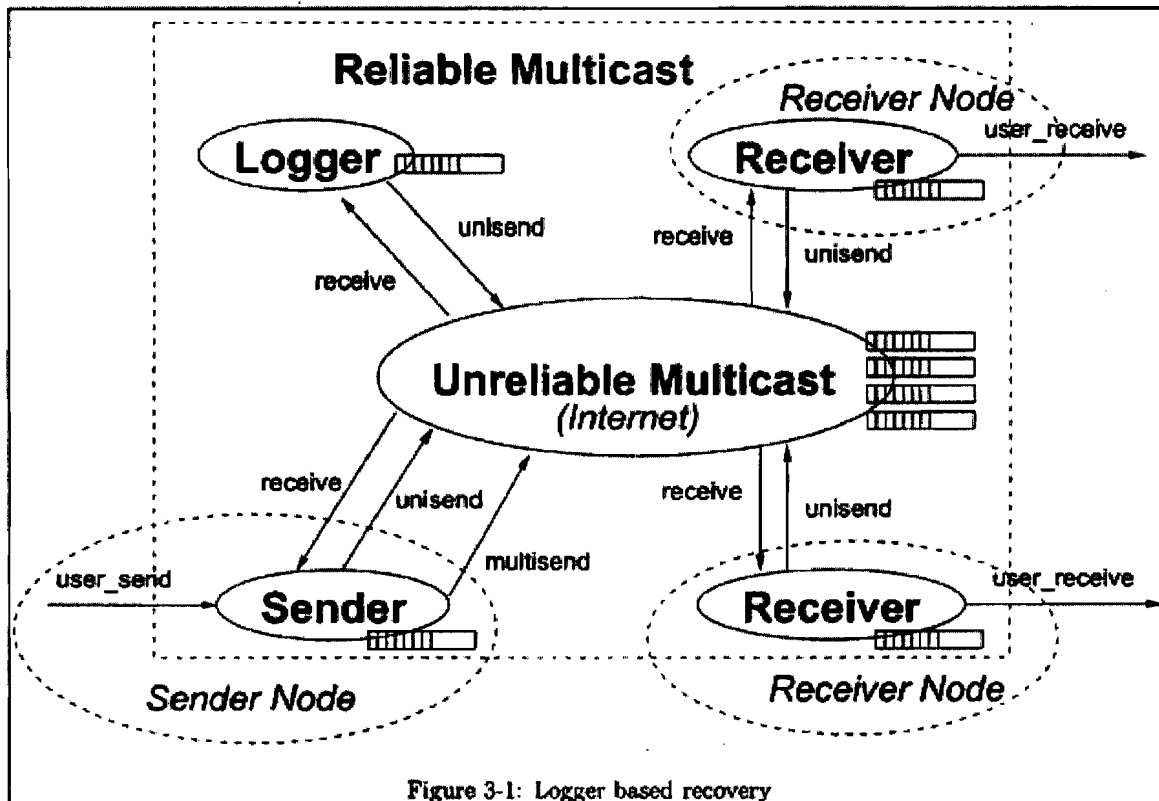
Regarding claims 13 and 29, *Sun* anticipates the publish/subscribe messaging system of claims 10 and 26 wherein the active connection is a TCP/IP connection (Figure 3-1).

Office Action dated May 16, 2007, p. 9.

Amended claim 29 is as follows:

29. The method of claim 26, wherein the active connection is a transmission control protocol / internet protocol connection.

Sun fails to disclose all of the features of amended claim 29. Specifically, *Sun* fails to disclose the feature wherein the active connection is a transmission control protocol/internet protocol connection. The Examiner cites portions of *Sun* with respect to the feature “wherein the active connection is a TCP/IP connection,” as recited in original claim 29. Applicants now address these portions of *Sun* to show that *Sun* fails to disclose the feature wherein the active connection is a transmission control protocol/internet protocol connection, as recited in amended claim 29. The Examiner cites Figure 3-1 of *Sun*, which is reproduced below for ease of reference:



Sun, Figure 3-1.

Neither the cited portion nor any other portion of *Sun* discloses the feature wherein the active connection is a transmission control protocol/internet protocol connection. The cited portion illustrates a setup for logger-based recovery. The cited figure shows that an unreliable protocol, such as the internet, is used for routing messages between senders and receivers. The figure also illustrates a reliable multicast. However, the cited figure nowhere mentions a transmission control protocol/internet protocol connection.

On the other hand, amended claim 29 recites the feature wherein the active connection is a transmission control protocol/internet protocol connection, and contains all of the limitations of the parent claims. The cited figure differs from the claimed feature because the cited figure discloses only a reliable

and unreliable multicast, but nowhere mentions transmission control protocol/internet protocol. Many reliable multicast protocols exist today, including Reliable Multicast Transport Protocol (RMTP), Scalable Reliable Multicast (SRM), and QuickSilver Scalable Multicast (QSM). The cited figure nowhere discloses any specific type of protocol such as the examples given, let alone a transmission control protocol/internet protocol. Therefore, *Sun* fails to disclose the feature wherein the active connection is a transmission control protocol/internet protocol connection. Accordingly, *Sun* does not disclose all of the features of amended 29. Amended claim 29 is representative of amended claims 15, 16, 31, and 32 because amended claims 15, 16, 31, and 32 each cite user datagram protocol and transmission control protocol connections, against which the Examiner also cites Figure 3-1. Hence, because amended claim 29 is representative of amended claims 13, 15, 16, 31, and 32, *Sun* also fails to disclose all of the features of amended claims 13, 15, 16, 31, and 32.

VI. Conclusion

The subject application is patentable over the cited reference and should now be in condition for allowance. The Examiner is invited to call the undersigned at the below-listed telephone number if in the opinion of the Examiner such a telephone conference would expedite or aid the prosecution and examination of this application.

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Respectfully submitted,

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